THE ORIGIN OF OUTER RINGS AROUND LUNAR BASINS, R. L. Cole and R. A. De Hon, Department of Geosciences, Northeast Louisiana University, Monroe, LA 71209.

The large, circular multi-ringed basins of the moon are presently recognized by most observers as impact structures, but the extent of the original crater of excavation remains a moot question. The outer, raised ring of the basin has been attributed to a concentric ring fault of magaterrace beyond the original impact crater (1-3); or alternately, it has been designated the limit of excavation of the basin cavity analogous to the rim crest of a crater (4-5). A photogeologic study of the comparative morphology of outer basin rings, crater rim crests, and fault scarps was undertaken in an attempt to differentiate a plausible origin for the outer ring of double and multi-ringed basins.

The three basins chosen for the study, Orientale, Nectaris, and Humboldtianum basins, provide a range in basin size and age. They were selected for this initial study because they are relatively free from the masking effects of younger mare-material near the outer ring and because adequate spacecraft imagery is available from the Orbiter series. The topographic limit of the Orientale Basin is the Montes Cordillera which forms a continuous mountainous ring 930 km in diameter. The Inner and Outer Montes Rook form two raised rings interior to the Cordillera ring. Mare material fills only the inner basin and isolated topographic lows between the concentric rings. The outer ring of the Nectaris Basin is 840 km in diameter and composed in part by the Rupes Altai. Mare basalts are limited to the central basin. The Humboldtianum Basin is characterized by an incomplete 600 km diameter outer ring and a 300 km diameter inner ring. Mare basalts occupy only a small portion of the inner basin and small patches between the concentric rings as well as the surface beyond the outer ring.

As an initial test, the rings were examined by photogeologic methods for criteria indicating a fault origin. The few features suggestive of faulting are largely ambiguous and nonconclusive. The chief argument for a fault origin for the ring is the imposing inward-facing ring scarp which marks an abrupt change in elevation and character of terrain. On the other hand, no definitive fault characteristics are observed at any of the ringed basins. There are no offset features, such as craters, rilles, or other topographic alinements.

The outer rings of basins are more like the rims of craters (6). The rim crest of a crater marks the boundary of hummocky and lineate topography of the rim deposit from the steep, often terraced, inner wall of the crater. The wall of the crater is essentially the limit of excavation which may be slightly to severely altered by post-impact modification. In like manner the outer ring of basins separates two distinct terrains. The outer hummocky terrain is continuous and complete, surrounding

the Orientale Basin where it is mapped as the Hevelius Formation. The outer hummocky facies is discontinuous around the Nectaris basin (Jansen Formation) and the Humboldtianum Basin. The degradation of basin related hummocky terrain is similar to the degradation of rim deposits around normal craters.

As a final test, crater frequency studies were performed for the regions on either side of the rings of each basin. At each basin, overall crater frequency is greater outside the ring and lower inside the ring. Such a relationship would not be expected for a ring fault separating surfaces of the same age. The difference in crater counts is consistent with surfaces of different ages. The lower, inner count corresponds to the cratering of the basin shelf and records the craters formed after the formation of the basin. The exterior surface retains some large remnant craters formed prior to the formation of the basin as well as craters formed after the formation of the basin.

In summary, the outer rings surrounding lunar basins are interpreted as the topographic limit of excavation of the basin. Supporting data for this conclusion include:

1. Absence of positive criteria for faulting at the outer rim scarp;
2. Morphological similarity between basin rings and crater rims;
3. Crater frequency studies which indicate a surplus of craters exterior to the basin outer ring.

References

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